Australian Government

Department of Defence
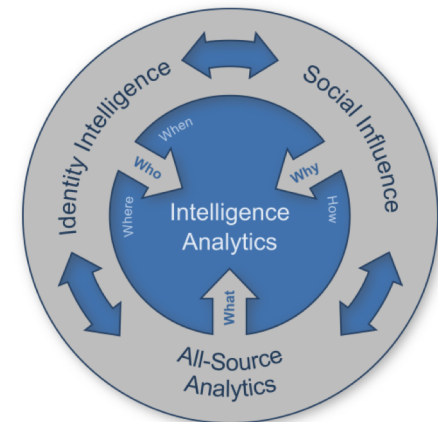Defence Science and Technology Group

Australian Government FR Algorithm Performance Testing
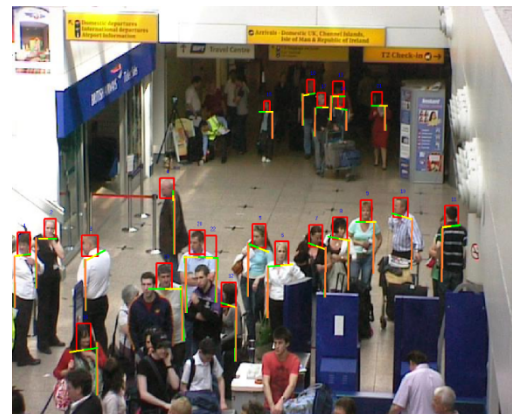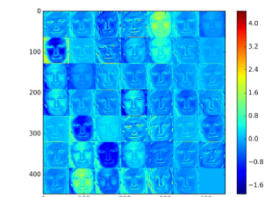## *International Face Performance Conference 2018*

Chris Malec

Dana Michalski, Martyn Hole
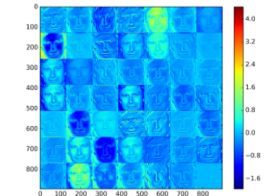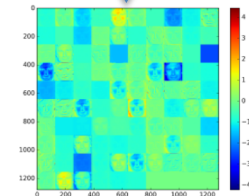
Science and Technology for Safeguarding Australia

Biometrics at DST Group: Overview

- Small, multidisciplinary team, est. 2000
  - Sits within the Intelligence Analytics Branch of National Security & Intelligence, Surveillance and Reconnaissance Division

- Focus on facial recognition
  - Main partners: intelligence, law enforcement, and border security agencies

- Streams of work
  - Technical and human factors
  - Evaluation, trials, development and applied research

DST Group
- ~2000 scientists
- S&T support to Defence and National Security

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Biometrics Group Overview
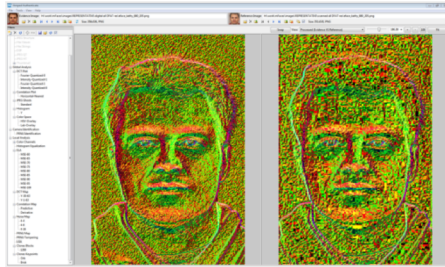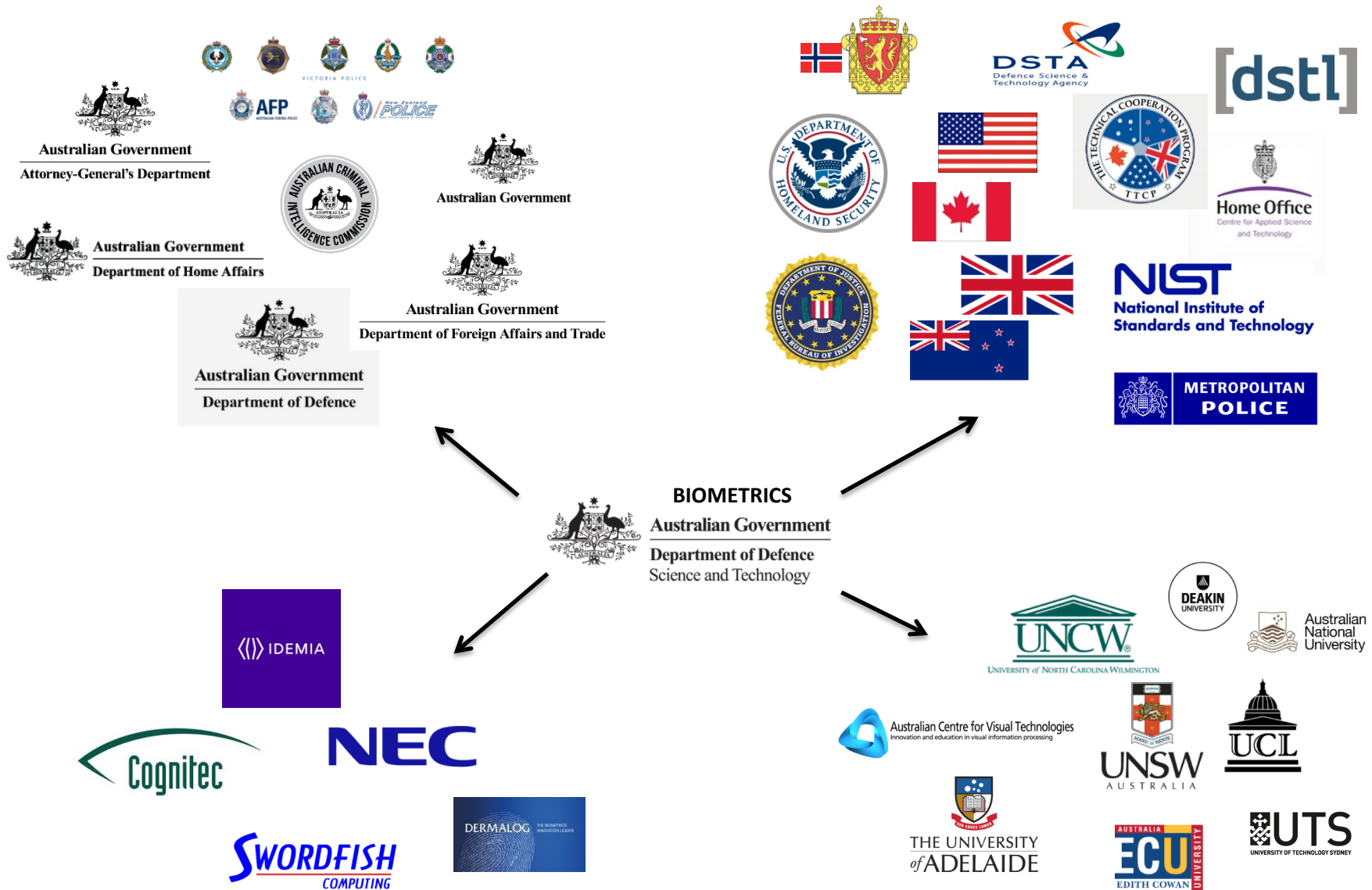
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BIOMETRICS
Australian Government
Department of Defence
Science and Technology

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Cascading Algorithms

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Cascading Algorithms

1:N Search

Candidate List

Primary Candidate List

X
1000

1000 x 1:1
Matches

Final Candidate List
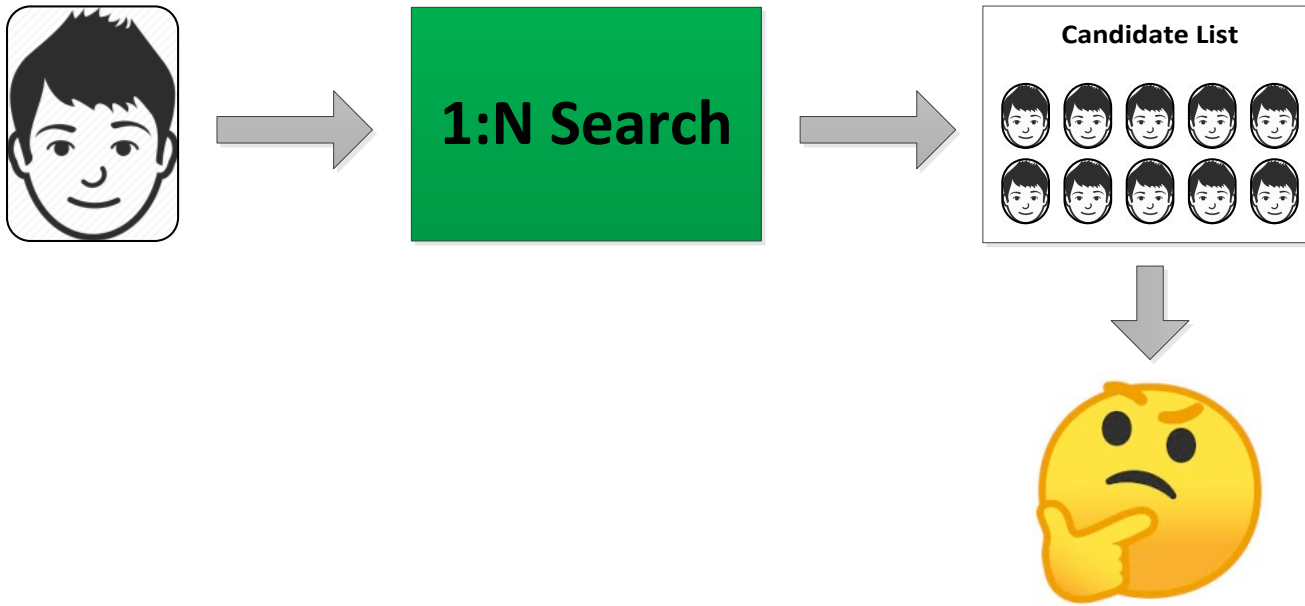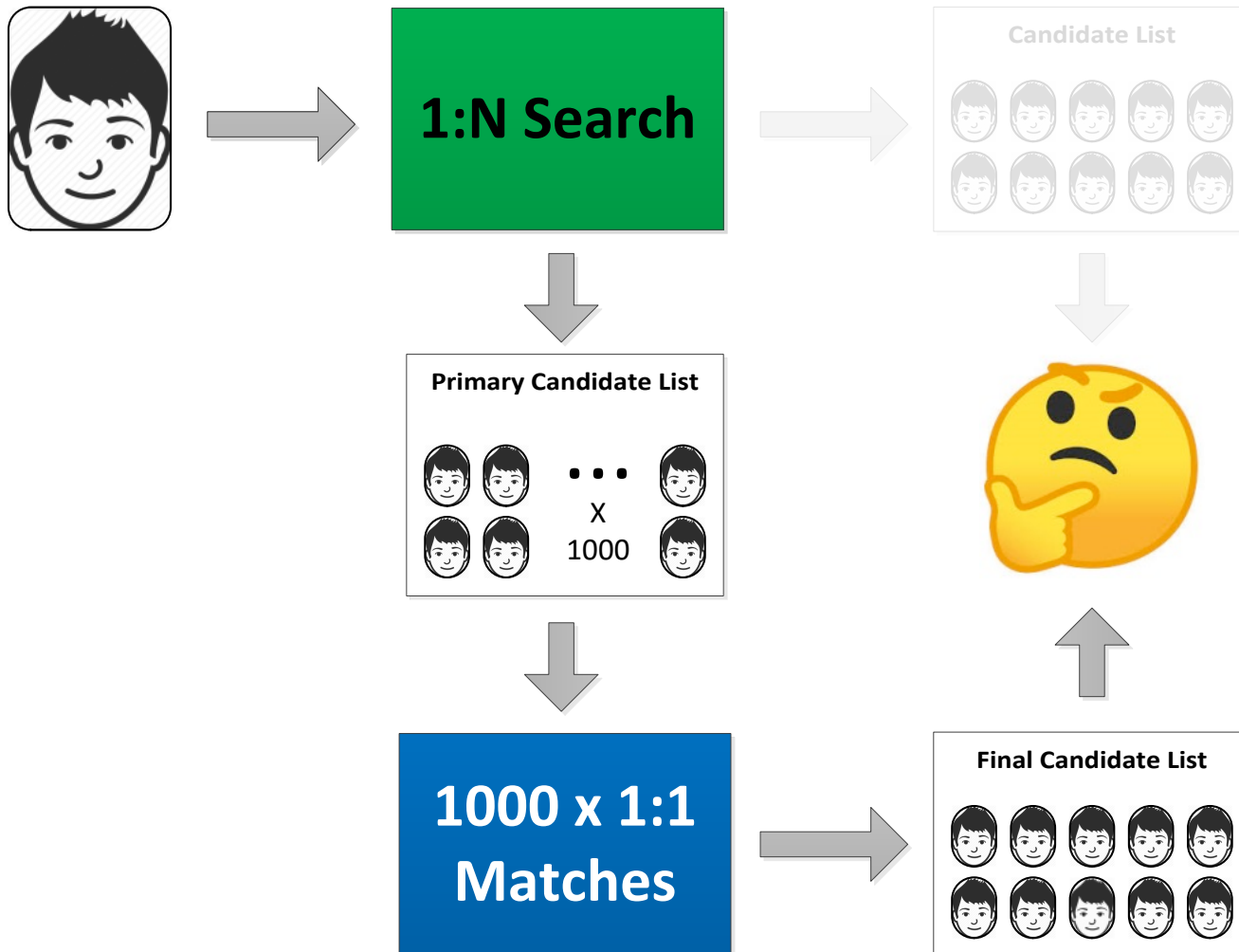
Cascading Algorithms

- How we assessed the performance:
  - 100k mated probes
  - 100k non-mated probes
  - Gallery = 15M
  - Only 1 image per id in gallery
  - Top 1000 returned by primary algorithm
  - Up to top 10 returned by secondary algorithm

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Cascading Algorithms
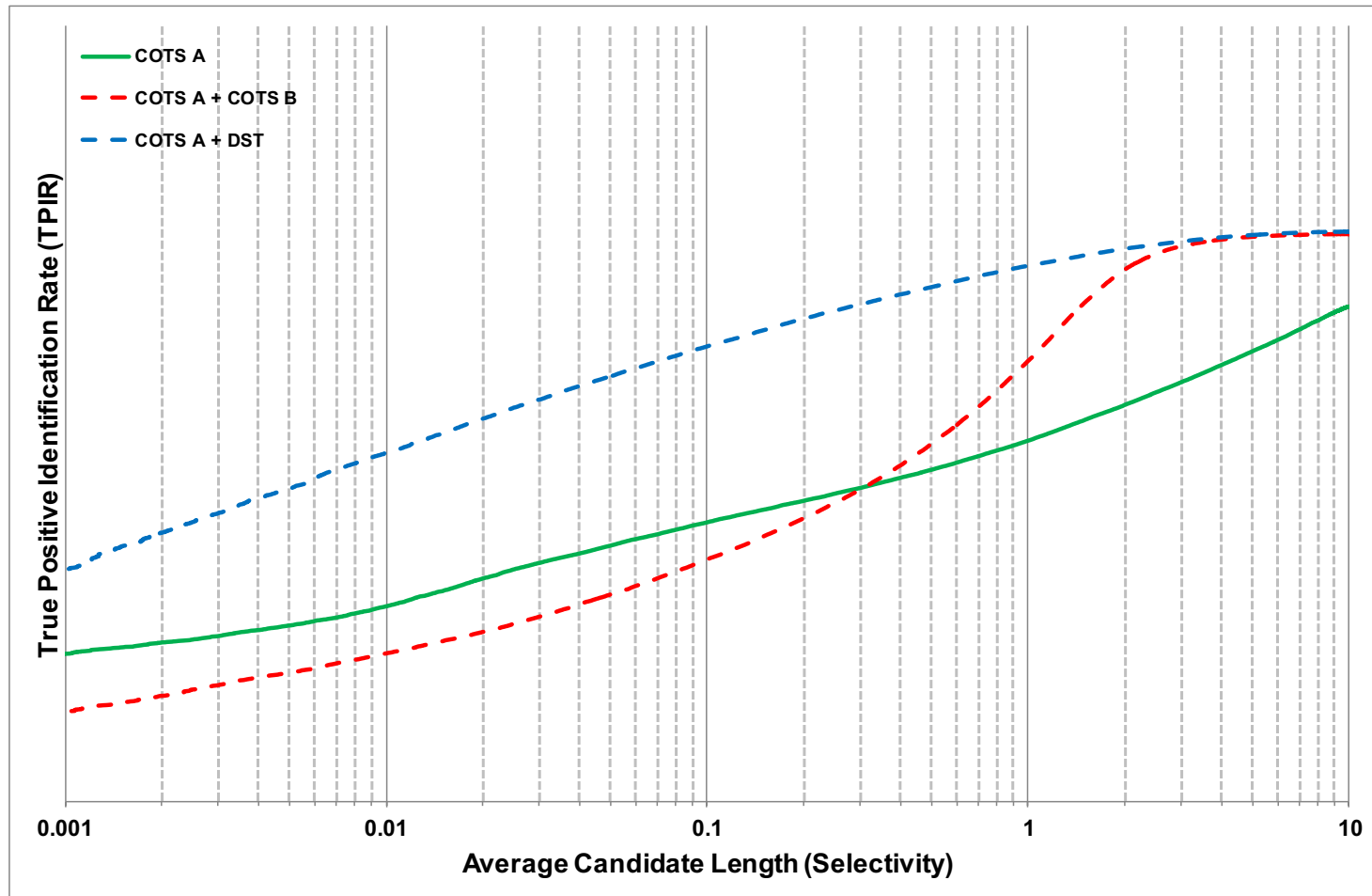
Baseline Performance

Normalisation

$$z = \frac{x - \mu}{\sigma}$$
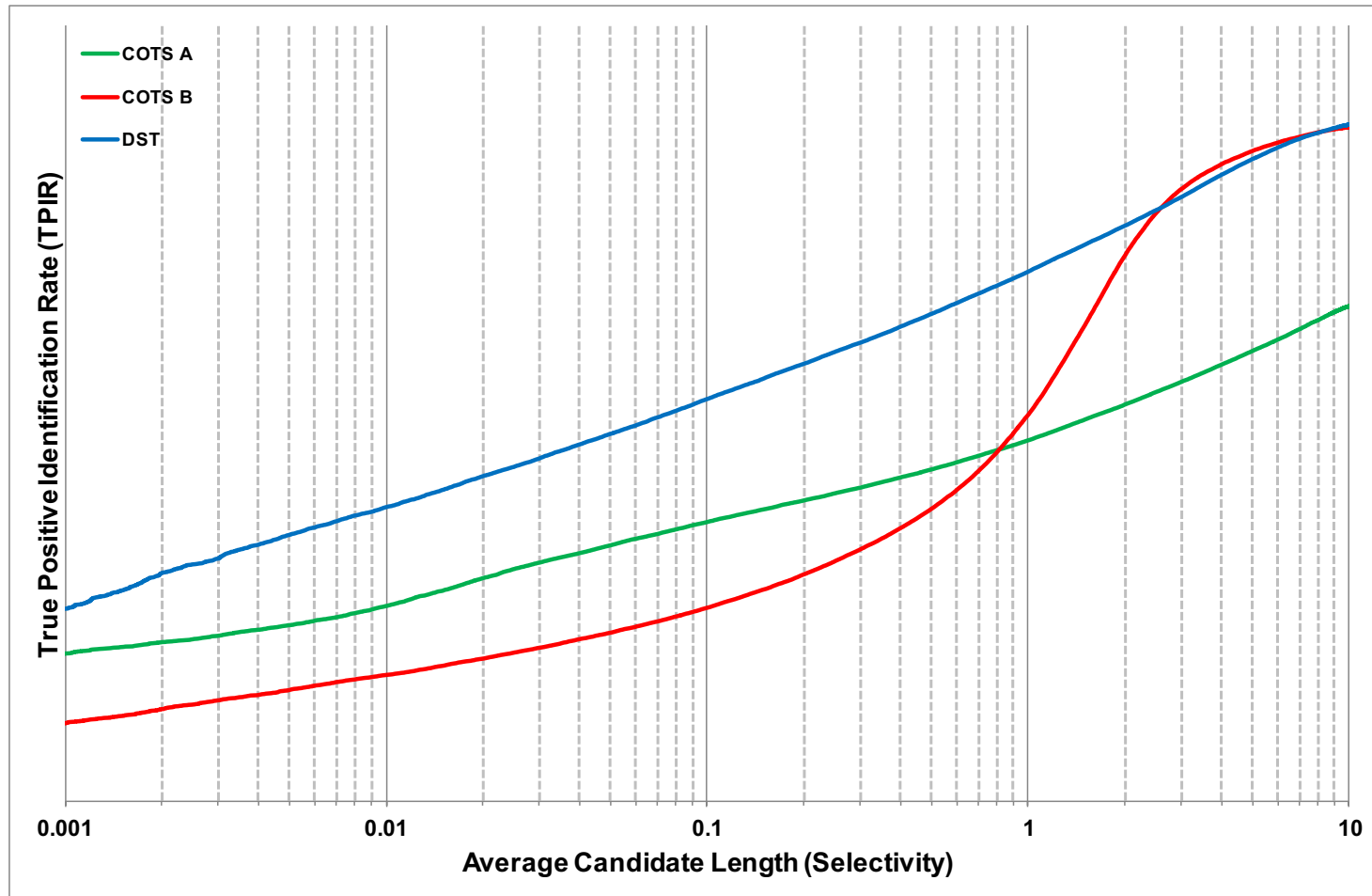
μ = Mean
σ = Standard deviation

- Z-score normalises the scores using the distribution scores of each probe against the gallery

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Normalisation

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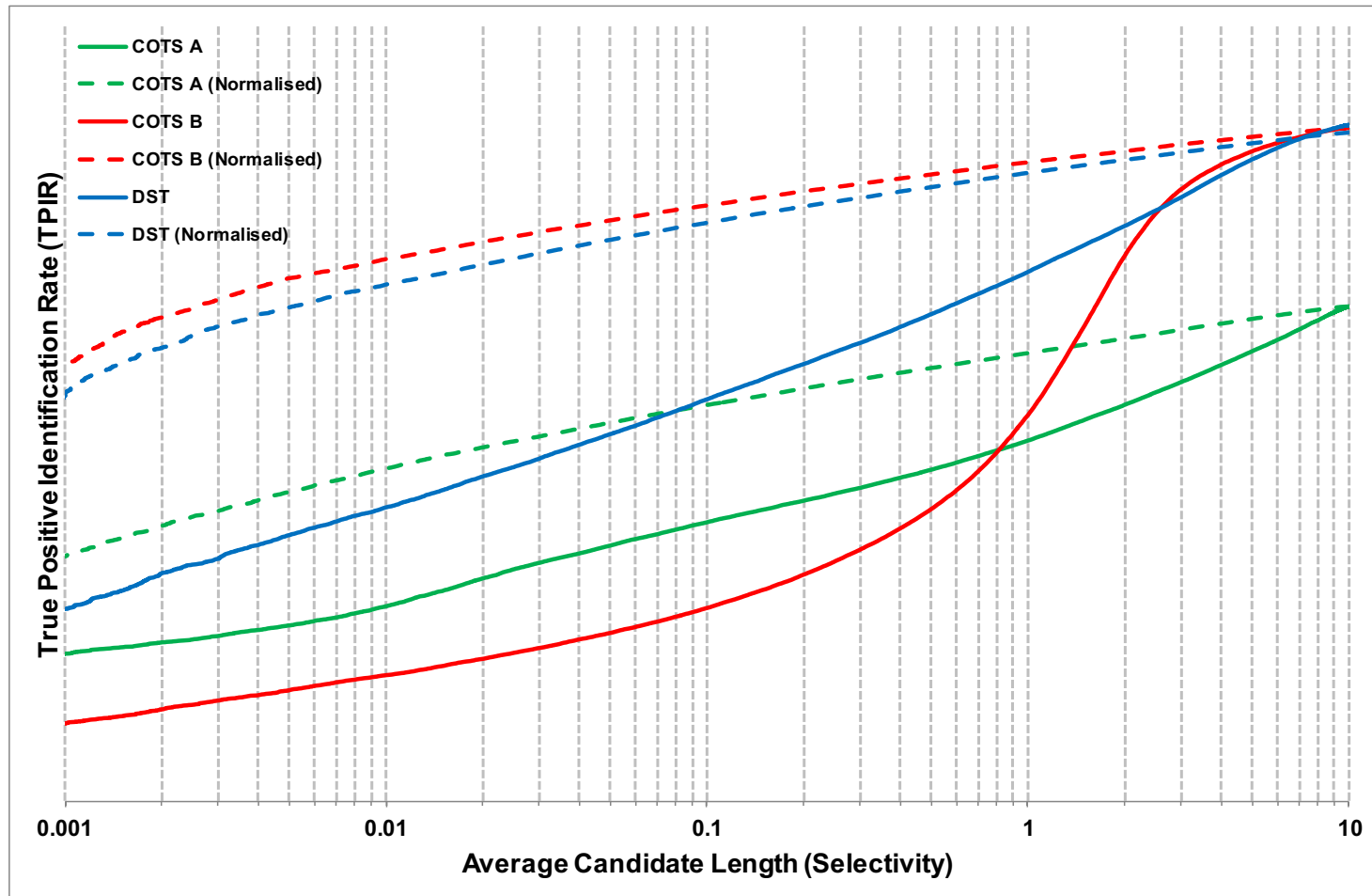
Child Identification Program

- Assessment of current performance

- Impact on operational systems

- Investigate ways to improve performance

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FMR for Children at each Age & Age Variation Based on FMR=0.001 set using Images of Adults

Age Variation (Years)

Youngest Age of Child In Image Pair (Years)	0	1	2	3	4	5	6	7	8	9	10
0	0.1164	0.0266	0.0111	0.0048	0.0028	0.0019	0.0009	0.0004	0.0002	0.0002	0.0001
1	0.0867	0.0465	0.0218	0.0158	0.0088	0.0052	0.0026	0.0015	0.0009	0.0004	0.0003
2	0.0508	0.0305	0.0264	0.0200	0.0104	0.0062	0.0034	0.0020	0.0011	0.0006	0.0003
3	0.0325	0.0329	0.0277	0.0174	0.0094	0.0060	0.0035	0.0023	0.0013	0.0005	0.0002
4	0.0303	0.0279	0.0199	0.0138	0.0081	0.0055	0.0034	0.0019	0.0008	0.0003	0.0001
5	0.0221	0.0225	0.0149	0.0108	0.0070	0.0049	0.0027	0.0013	0.0005	0.0002	0.0001
6	0.0235	0.0155	0.0115	0.0079	0.0056	0.0036	0.0019	0.0007	0.0003	0.0001	0.0001
7	0.0156	0.0138	0.0092	0.0070	0.0041	0.0025	0.0011	0.0006	0.0003	0.0001	0.0001
8	0.0142	0.0104	0.0066	0.0051	0.0026	0.0015	0.0006	0.0003	0.0001	0.0002	0.0001
9	0.0100	0.0078	0.0038	0.0036	0.0013	0.0008	0.0004	0.0002	0.0001	0.0001	0.0001
10	0.0063	0.0051	0.0025	0.0015	0.0008	0.0005	0.0003	0.0001	0.0001	0.0001	0.0001
11	0.0040	0.0032	0.0023	0.0011	0.0006	0.0004	0.0002	0.0002	0.0001	0.0001	0.0001
12	0.0039	0.0019	0.0014	0.0006	0.0005	0.0003	0.0002	0.0002	0.0001	0.0001	0.0001
13	0.0015	0.0011	0.0008	0.0008	0.0004	0.0003	0.0002	0.0002	0.0001	0.0001	0.0001
14	0.0011	0.0014	0.0007	0.0005	0.0004	0.0003	0.0002	0.0002	0.0002	0.0001	0.0001
15	0.0009	0.0010	0.0005	0.0004	0.0003	0.0003	0.0002	0.0002	0.0002	0.0001	0.0001
16	0.0007	0.0006	0.0005	0.0004	0.0003	0.0003	0.0002	0.0002	0.0001	0.0001	0.0001
17	0.0004	0.0004	0.0005	0.0004	0.0003	0.0002	0.0002	0.0002	0.0001	0.0001	0.0002

Worst Performance

Midpoint

Best Performance

FNMR for Children at each Age & Age Variation Based on FMR=0.001 set using Images of Adults

Age Variation (Years)

Youngest Age of Child In Image Pair (Years)	0	1	2	3	4	5	6	7	8	9	10
0	0.344	0.477	0.568	0.652	0.704	0.731	0.783	0.837	0.897	0.933	0.951
1	0.052	0.119	0.166	0.248	0.287	0.335	0.418	0.497	0.590	0.698	0.768
2	0.034	0.041	0.100	0.134	0.183	0.205	0.266	0.324	0.417	0.553	0.662
3	0.050	0.053	0.073	0.106	0.124	0.155	0.200	0.266	0.361	0.505	0.615
4	0.028	0.051	0.065	0.082	0.096	0.118	0.168	0.237	0.360	0.505	0.599
5	0.033	0.048	0.049	0.069	0.076	0.101	0.149	0.224	0.361	0.476	0.561
6	0.029	0.031	0.033	0.048	0.069	0.092	0.151	0.232	0.360	0.453	0.525
7	0.032	0.023	0.020	0.046	0.065	0.093	0.160	0.249	0.337	0.412	0.456
8	0.024	0.013	0.033	0.046	0.070	0.105	0.174	0.242	0.312	0.369	0.422
9	0.008	0.011	0.038	0.054	0.084	0.118	0.172	0.227	0.273	0.328	0.370
10	0.015	0.012	0.028	0.052	0.089	0.119	0.166	0.199	0.240	0.284	0.325
11	0.005	0.014	0.024	0.076	0.091	0.116	0.143	0.187	0.219	0.260	0.286
12	0.025	0.020	0.037	0.056	0.076	0.093	0.121	0.151	0.187	0.217	0.254
13	0.008	0.021	0.038	0.051	0.061	0.070	0.098	0.116	0.141	0.167	0.202
14	0.011	0.012	0.020	0.036	0.043	0.055	0.070	0.085	0.106	0.126	0.152
15	0.005	0.011	0.013	0.026	0.034	0.043	0.056	0.069	0.083	0.101	0.129
16	0.008	0.010	0.018	0.024	0.027	0.034	0.043	0.053	0.068	0.089	0.095
17	0.009	0.006	0.011	0.018	0.023	0.028	0.037	0.043	0.057	0.069	0.088

Worst Performance
Midpoint
Best Performance

Science and Technology for Safeguarding Australia

Threshold Variation
FNMR when FMR=0.001 for each Age & Age Variation

Age Variation (Years)

Youngest Age of Child in Image Pair (Years)	0	1	2	3	4	5	6	7	8	9	10
0	0.736	0.752	0.756	0.782	0.785	0.785	0.778	0.782	0.833	0.846	0.848
1	0.335	0.397	0.420	0.510	0.511	0.504	0.519	0.541	0.576	0.610	0.645
2	0.278	0.216	0.316	0.348	0.375	0.361	0.372	0.392	0.424	0.499	0.541
3	0.202	0.186	0.270	0.313	0.276	0.273	0.300	0.341	0.388	0.441	0.473
4	0.167	0.195	0.197	0.224	0.210	0.223	0.247	0.280	0.346	0.389	0.415
5	0.128	0.160	0.172	0.163	0.164	0.183	0.208	0.244	0.308	0.324	0.352
6	0.138	0.098	0.107	0.118	0.143	0.154	0.189	0.211	0.267	0.280	0.317
7	0.114	0.109	0.063	0.129	0.117	0.130	0.167	0.202	0.213	0.236	0.238
8	0.048	0.054	0.075	0.085	0.105	0.123	0.148	0.174	0.190	0.206	0.211
9	0.025	0.038	0.053	0.079	0.095	0.106	0.126	0.141	0.155	0.175	0.179
10	0.041	0.033	0.041	0.064	0.082	0.091	0.111	0.110	0.123	0.136	0.157
11	0.012	0.027	0.027	0.077	0.074	0.078	0.085	0.104	0.108	0.126	0.134
12	0.045	0.028	0.038	0.038	0.052	0.059	0.069	0.082	0.094	0.103	0.119
13	0.008	0.021	0.031	0.039	0.040	0.041	0.056	0.065	0.066	0.073	0.095
14	0.011	0.012	0.019	0.024	0.026	0.032	0.037	0.041	0.049	0.057	0.069
15	0.005	0.011	0.008	0.018	0.020	0.024	0.029	0.035	0.041	0.046	0.050
16	0.008	0.009	0.011	0.014	0.015	0.017	0.021	0.022	0.027	0.034	0.031
17	0.005	0.005	0.006	0.012	0.011	0.013	0.018	0.018	0.024	0.028	0.031

Worst Performance

Midpoint
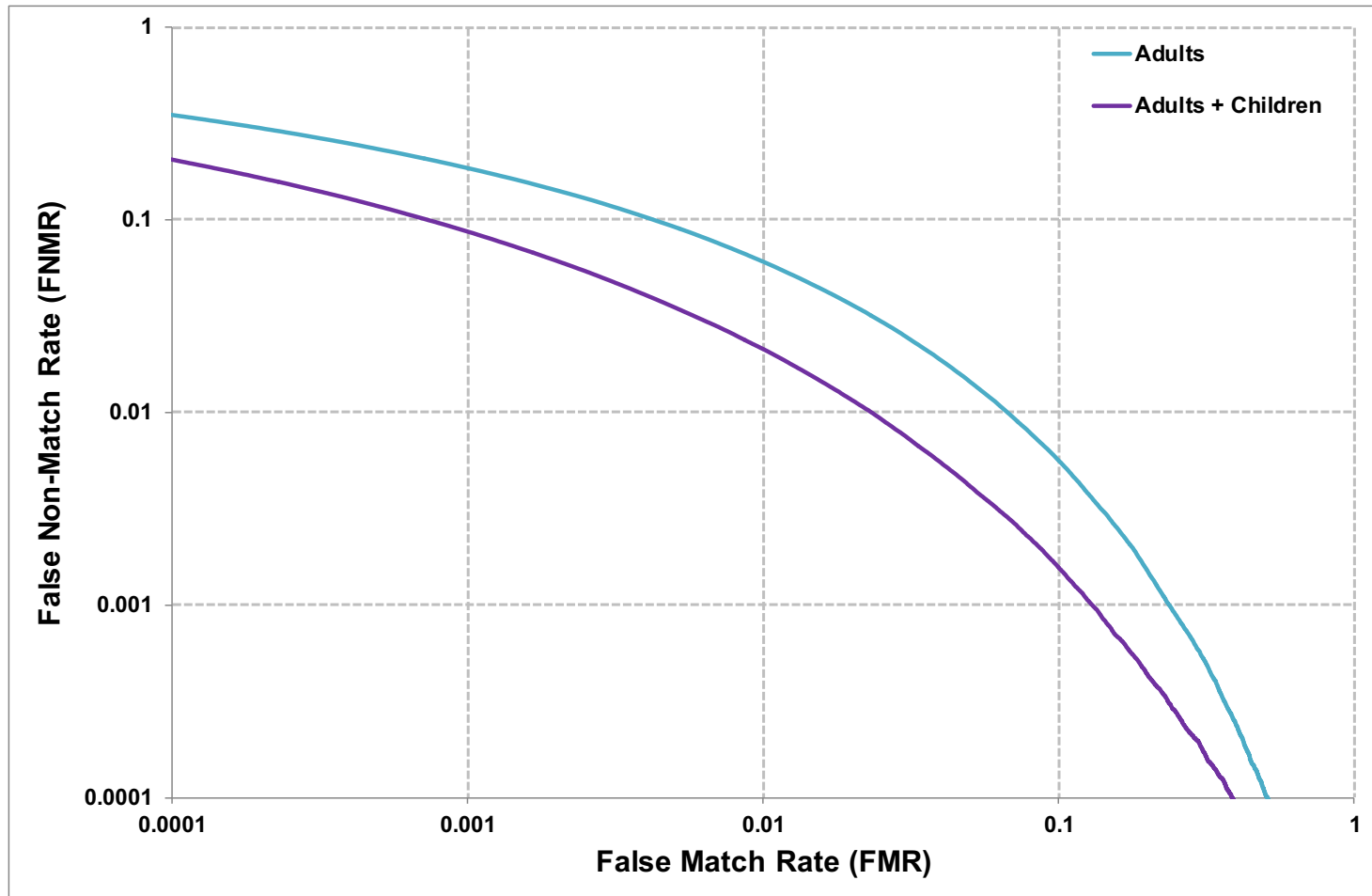
Best Performance

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Child Identification Program
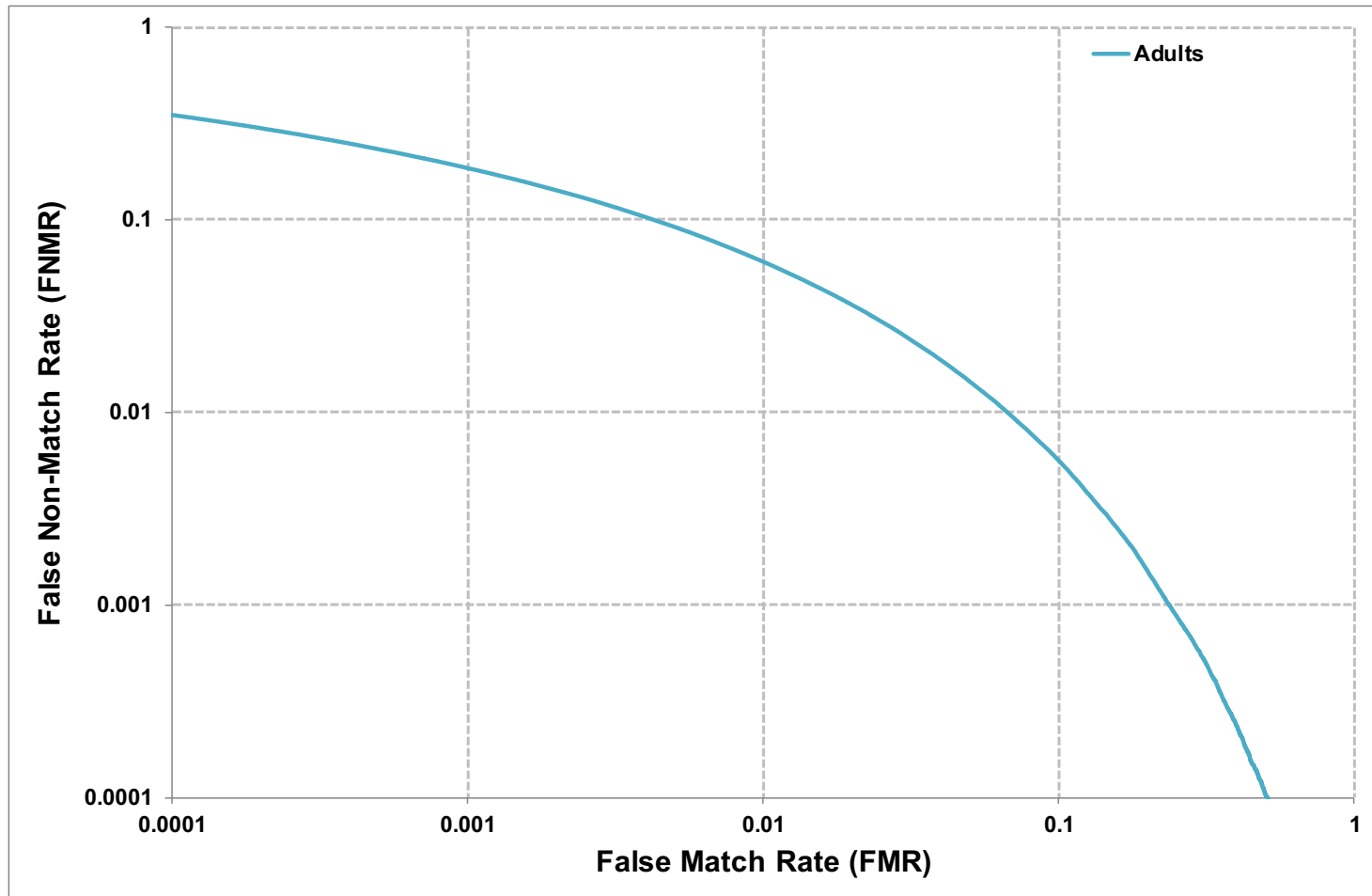
Child Identification Program

Summary

- Collaborative approach across Australian Government has proved valuable

- Thank you to everyone involved:
  - Other Government agencies
  - Vendors

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